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Efficacy of Toltrazuril 5% Suspension (Baycox®, Bayer) and Diclazuril (Vecoxan®, Janssen-Cilag) in the Control of *Eimeria* spp. in Lambs

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Abstract

Sheep coccidiosis is a pathology caused by protozoan parasites of the genus *Eimeria* spp. with clinical and economic effect especially in young animals (Ambrosi 1995; Pellérdy 1974). A field study was conducted to evaluate the efficacy of a metaphylactic treatment with toltrazuril 5% suspension (Baycox®, Bayer) in comparison with diclazuril (Vecoxan®, Janssen-Cilag) and untreated controls against naturally acquired *Eimeria* infections in housed lambs. A total of 170 animals, aged 24 to 34 days and randomly divided in three homogeneous groups, were included in the study. The assessment of treatment efficacy was based on total faecal oocyst excretion (opg) and count reduction (FOCR) in the two groups of animals treated with toltrazuril (TOLT) and diclazuril (DICL) compared with untreated control group (C). The animals treated with toltrazuril showed a considerably lower mean opg to that of group C (5.78 opg versus 144.62 opg) ($p < 0.05$) and a FOCR of 97.7%. The higher efficacy (99.23%) was observed at 15 days post treatment; however, the average efficacy of the

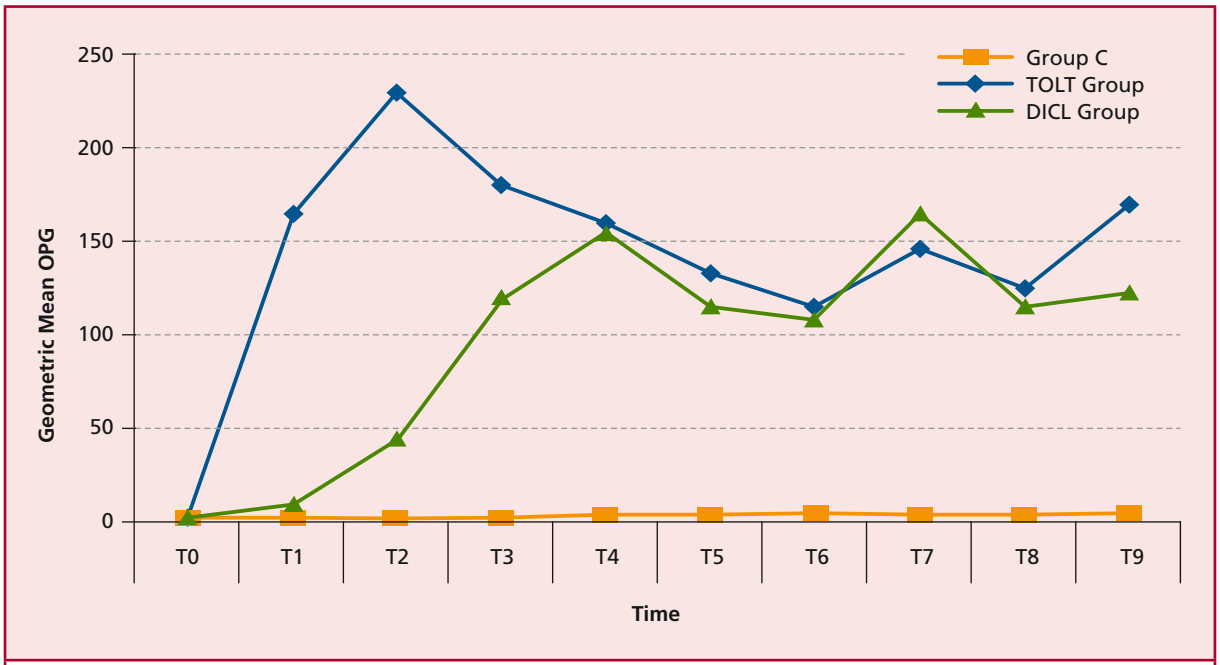

Fig. 1 Geometric mean opg of *Eimeria* spp. in lambs

drug remained extremely high (>90%) for all the study. The lambs treated with diclazuril showed an intense, persistent oocyst excretion with average levels of 97.54 opg, ($p < 0.05$). This study demonstrates the good efficacy of toltrazuril administered orally to lambs in the prepatent period in subclinical natural *Eimeria* infections in housed lambs.

Introduction

Coccidial infections of sheep have been observed in almost all sheep-rearing countries in the world (Pellérdy 1974) and it is assumed that most, if not all, domestic ruminants become infected with coccidia during their lives (Taylor and Catchpole 1994). Of the 15 ovine *Eimeria* species known to infect sheep, two are considered to be most pathogenic, *E. ovinoidalis* and *E. crandallis* (Pellérdy 1974; Gregory 1990). In the majority of hosts, the parasites coexist causing minimal damage. Clinical eimeriosis only occurs if the host is subjected to heavy infection or if its resistance is lowered (Taylor 1995). All age groups are susceptible to infection, but disease outbreaks are usually restricted to younger animals (Taylor and Catchpole 1994). Gregory and Catchpole (1989) showed that susceptibility of lambs to *E. ovinoidalis* and *E. crandallis* increases progressively up to at least 4 weeks of age. Possible sources of infection in this period are: (i) the small numbers of oocysts excreted by the ewes, particularly around the periparturient period when the ewe's immune status is lowered (Coop and Wright 2000); (ii) oocysts surviving in old faecal contamination of the lambing area arising from previous occupation (Pout 1973); (iii) oocysts shed by other lambs (Gregory et al. 1983). Depending on the rearing conditions, lambs are mostly affected by clinical eimeriosis around 6 weeks of age or when animals are moved to feedlots (Foreyt 1990). The parasite population increases enormously during the first passages in susceptible animals, and lambs born later are therefore at greater risk (Catchpole et al. 1993). According to Yvoré et al. (1980), the disease appears mostly under stressful conditions, particularly after weaning. Housed lambs reared on

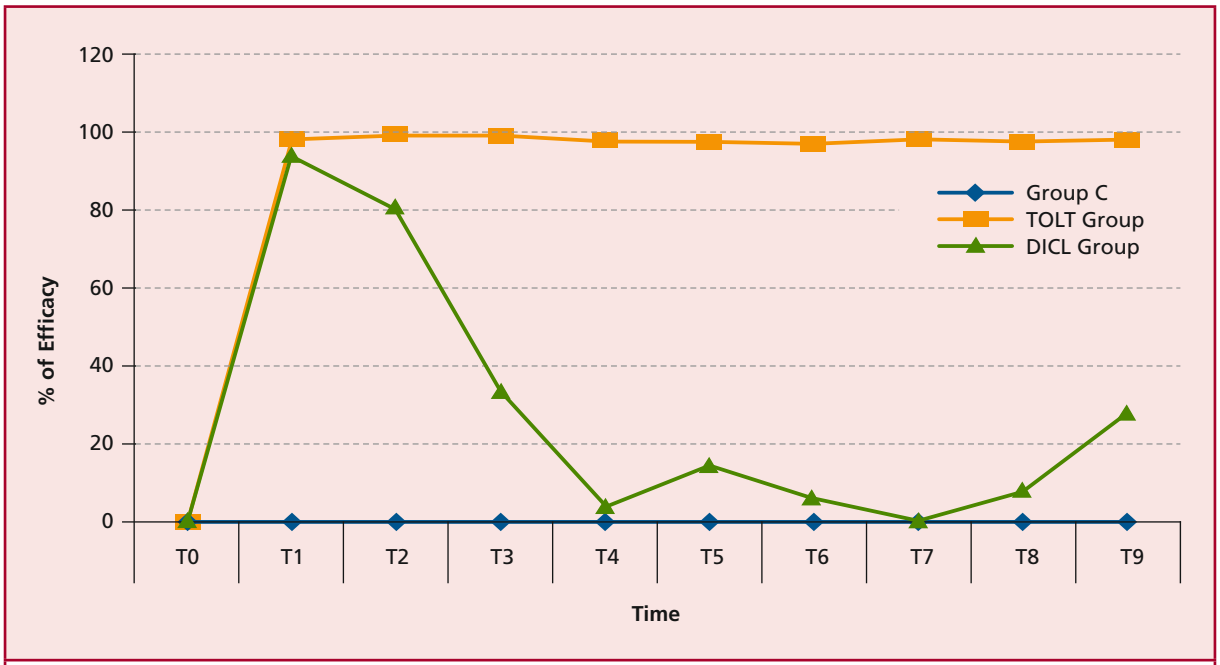

Fig. 2 Percentage reduction in faecal oocyst counts per gram (opg) of *Eimeria* spp. in lambs

straw appear to be at particular risk from eimeriosis. A high stocking density predisposes to heavy environmental contamination, which is ideal for oocyst survival and rapid sporulation due to suitable temperature, oxygen and moisture (Berriatua et al. 1994). Although hygienic measures can reduce infection pressure, they are difficult to implement once susceptible animals are housed together, especially indoors where oocysts rapidly accumulate. Therefore, control with anticoccidial drugs is frequently necessary to prevent clinical outbreaks and production losses. The purpose of this work is to verify under field conditions the efficacy of a metaphylactic treatment with toltrazuril 5% suspension (Baycox®, Bayer) and diclazuril (Vecoxan® Janssen-Cilag) on natural infections in sheep caused by the coccidia *Eimeria*.

Materials and methods

The study was carried out between October and December 2011. One hundred and seventy female replacement Sarda lambs aged between 20 and 34 days were included in the experiment. At the start of the experiment, no animal had received either anticoccidial and/or coccidiostat treatment or had shown any clinical sign of coccidiosis. The selected animals were assigned at random to three groups of 50 (toltrazuril treatment group TOLT), 50 (diclazuril treatment groups DICL) and 70 (negative control group C) animals, respectively. The TOLT group was treated (T_0) with a single dose (20 mg/kg) of ovine toltrazuril oral suspension (Baycox®, Bayer), the DICL group with a single dose (1 mg/kg) of diclazuril oral suspension (Vecoxan® Janssen-Cilag), and the group C animals received a corresponding volume of H_2O. Qualitative and quantitative copromicroscopic investigations (Ambrosi 1995) and a morphometric identification of the species (Levine 1961) were carried out on samples of faeces collected individually beginning from the day of treatment (T_0) and subsequently once a week for the following 9 weeks (T_1, T_2, …T_9). In addition, for each week during the controls scheduled by the experimental protocol,

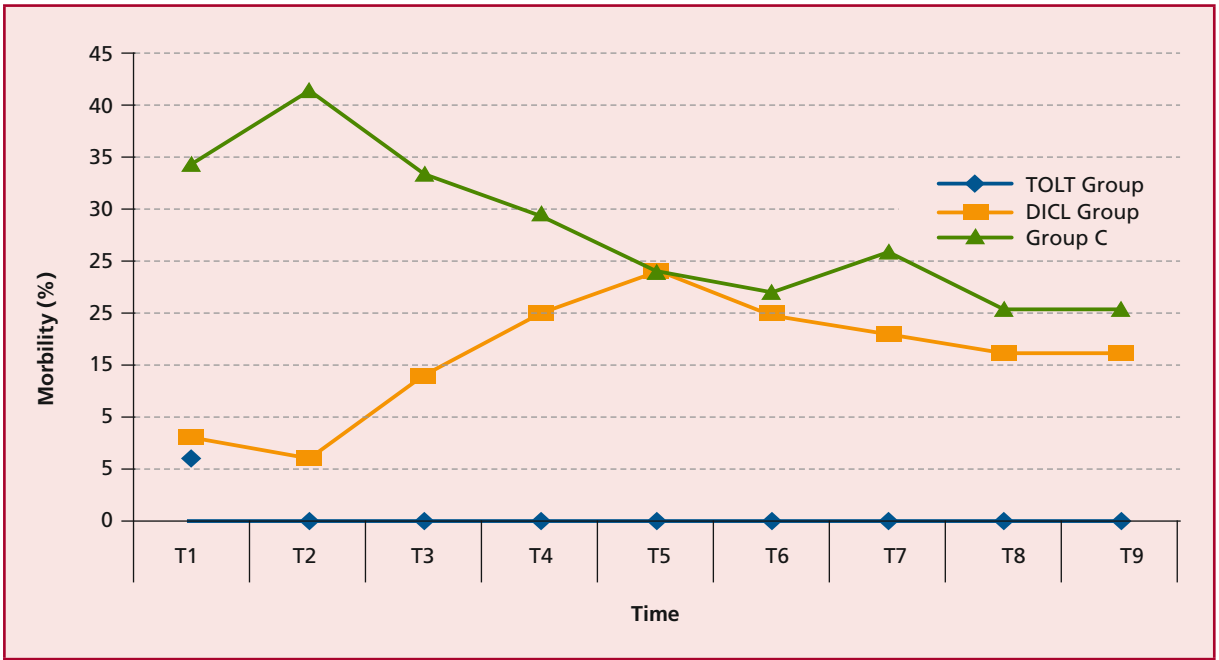

Fig. 3 Percentage of clinical symptoms ascribable to coccidiosis

each sample of faeces was given a score based on consistency according to the following criterion: 0 = normal faecal consistency; 1 = soft unformed faeces; 2 = watery faeces; 3 = haemorrhagic faeces and presence of fragments of intestinal epithelium and fibrinous-haemorrhagic clots. The geometric mean (GM) for the oocyst excretion/gram of faeces (opg) of each experimental group was calculated at each sampling time and was compared by means of ANOVA with that of the other experimental groups. The efficacy of the treatments was assessed by calculating the percentages (%) of Faecal Oocyst Count Reduction (FOCR). The prevalence and predominance indices of each coccidial species were calculated on the basis of the results of the coprocultures according to the different test times. Finally, in order to analyse qualitative variables, such as the morbidity index (faecal score 2–3 associated with oocyst excretion), inferential analysis was used to assess and compare the frequency, i.e. the percentage of animals showing clinical symptoms belonging to the same group.

Results

All age groups of animals resulted infected by mixed coccidial infections. The animals in group C showed a constant oocyst excretion for all the study period (mean excretion: 144.62 opg; range min–max: 21.38–229.20 opg). The highest point of excretion, associated however with clinical symptoms, was observed at time T_2 and was followed by fluctuating excretion rates, which never fell below 125 opg. *E. ovinoidalis*, the most common species in terms of both prevalence and predominance during the first three weeks of the study, gradually decreased in favour of *Eimeria* spp. The variations in prevalence and predominance of *E. ahsata* and *E. crandallis* were less obvious compared to *E. ovinoidalis* throughout the test. Beginning from the first control post treatment (T_1), the TOLT group animals showed a considerably lower mean opg compared to that of group C (5.78 opg versus 144.62 opg) ($p<0.05$) with a FOCR of 97.7%. The highest efficacy (99.23%) was observed at time T_2, however, the average efficacy of the drug remained

extremely high (>90%) throughout the study. From time T_2, the species *E. ahsata*, *E. ovinoidalis* and *E. crandallis* disappeared completely, whereas the only species remaining were those included in the "*Eimeria* spp." group. As regards the DICL group at time T_1, the mean rate of opg in the animals treated was substantially lower than that of group C (10.36 opg versus 164.58 opg) ($p<0.05$), with a FOCR of 93.7% (point of maximum efficacy); however, the action of the drug became significantly more obvious up to time T_3 (FOCR: 33.52%). With the exception of the first 2 weeks post treatment, the lambs treated with diclazuril showed an intense, persistent oocyst excretion, with average levels of 97.54 opg, considerably higher than those recorded in the animals treated with toltrazuril ($p<0.05$) (Figs. 1 and 2). Furthermore, contrary to the TOLT group, *E. ahsata* and *E. crandallis* showed reasonably constant prevalence and predominance indices throughout the entire study, whereas the species *E. ovinoidalis* suffered a drastic reduction post treatment in favour of the species "*Eimeria* spp.", the prevalence and predominance of which continued to rise throughout the test. During the study, the lambs in group C showed the highest percentage of clinical symptoms ascribable to coccidiosis (23.49%), significantly higher than in the animals belonging to the TOLT group (0.6%) and the DICL group (15.70%) ($p<0.05$) (Fig. 3).

Conclusion

The results of this study showed that the treatment with toltrazuril, administered to animals within the first month of life and company medical history permitting, provides early, persistent elimination of the most highly pathogenic *Eimeria* species (*E. ahsata*, *E. ovinoidalis* and *E. crandallis*), showing a general improvement in the lambs' health. The product has, in fact, proved to be extremely and continually effective in the two months following treatment and determined a different development of the parasitism compared with the untreated group and with the group treated with diclazuril in terms of: a) percentage of lambs tested positive for coccidia; b) intensity of the infestations observed (mean opg excretions); c) frequency and seriousness of the enteric disorders; d) drastic reduction in the most pathogenic coccidial species. The obtained data are in accordance with similar previous works performed on French (Le Sueur et al. 2009) and Central German sheep farms (Mundt et al. 2009).

Ethical standards

All procedures were carried out in compliance with current Italian laws and European guidelines.

Conflict of interest

Bayer Animal Health provided financial support for this study. The authors declare that there were no competing interests and that the conceptual design, the conduct, the interpretation of results and all scientific aspects of the study were not influenced by Bayer.

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